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Divide these by at_1, at_2 respectively, and take one result from the other and divide by t_1-t_2; then

$$a(t_1^3+t_1^2t_2+t_1t_2^2)=2mt_1-4at_1 \quad\ldots\ldots\ldots\ldots(6).$$

Divide (4) by at_1 and take (6) from the result; then

$$at_1t_2(t_1+t_2)=-4n \quad\ldots\ldots\ldots\ldots(7).$$

But it can be shown that $t_1+t_2=-(2/t_1)$ ……………………(8).

Substituting in (7) and reducing, $t_2=(2n/a)=-t_1-(2/t_1)$ ……….(9),

which gives $t_1=\dfrac{-n+\sqrt{n^2-2a^2}}{a}$ ……………………………(10).

(10) in (6) gives $2n^2=am-a^2$ ……………………………(11),

the required locus of center of (1).

Also solved by *F. M. McGAW*.

[NOTE. Solution of Problen 69 will appear in the next issue. Editor.]

MECHANICS.

Conducted by B. F. FINKEL, Springfield, Mo. All contributions to this department should be sent to him.

SOLUTIONS OF PROBLEMS.

44. Proposed by O. W. ANTHONY, M. Sc., Professor of Mathematics, Columbian University, Washington, D. C.

There is a triangle whose sides repulse a center of force within the triangle with an intensity that varies inversely as the distance of the center of force from each point of the sides of the triangle. What the position of equilibrium of the center?

Solution by HENRY HEATON, M. Sc., Atlantic, Iowa.

Put p=altitude of the triangle upon the side a as base, s=distance of center of force from the side a, x=distance of any point of side a from the vertex B, y=distance of any point of the side b from the vertex C, and z=distance of any point of the side c from the vertex B.

The force exerted by any portion dx of the side a resolved perpendicular to it, is $msdx$ where m is an arbitrary constant depending on the intensity of the force. The forces exerted by portions dy and dz of the sides b and c are respectively $m[s-(b/p)y]dy$ and $m[s-(c/p)z]dz$. For equilibrium we have

$$m\int_0^a sdx+m\int_0^b(s-\frac{p}{b}y)dy+m\int_0^c(s-\frac{p}{c}z)dz=0.$$

$$\therefore\ (a+b+c)s=\tfrac{1}{2}p(b+c).\quad \therefore\ s=\frac{p(b+c)}{2\,(a+b+c)}.$$

Hence the distance of the center of force from the side a is $\dfrac{p(b+c)}{2(a+b+c)}$.

In like manner it may be shown that its distance from the side b is $\dfrac{q(a+c)}{2\,(a+b+c)}$, and that its distance from the side c is $\dfrac{r(a+b)}{2\,(a+b+c)}$, when q and r are the altitudes of the triangle upon the sides b and c respectively.

Also solved by *G. B. M. ZERR*. His solution will appear in the next issue.

45. Proposed by H. C. WHITAKER, A. M., Ph. D., Professor of Mathematics, Manual Training School, Philadelphia, Pennsylvania.

A fifty-pound cannon-ball is projected vertically upward with a velocity of 300 feet per second. Find the height to which it will rise and the time of flight, assuming the initial resistance of the air on the ball to be 10 pounds and the resistance to vary as the square of the velocity.

Solution by G. B. M. ZERR, A. M., Ph. D., Texarkana, Arkansas.

Let h=height required, t=time of ascent, t_1=time of descent, $T=t+t_1$= time of flight, v=velocity=300 feet per second. W=50 pounds, g=32.2 feet per second. $\mu v^2=10$ pounds$=\frac{1}{5}W$.

$$\therefore\ \mu=\frac{W}{5v^2}.\quad \frac{1}{k}=\sqrt{\frac{W}{\mu}}=v\sqrt{5}.\quad \therefore\ k=\frac{1}{v\sqrt{5}}.$$

From Bowser's Analytical Mechanics, pages 306-7, we get,

$$h=\frac{1}{2gk^2}\log(1+k^2v^2),\quad t=\frac{1}{gk}\tan^{-1}vk.$$

$$t_1=\frac{1}{gk}\log\{\sqrt{1+v^2k^2}+vk\}.$$

$$\therefore\ h=\frac{5v^2}{2g}\log(\tfrac{6}{5})=1273.9827 \text{ feet}.$$

$$t=\frac{v\sqrt{5}}{g}\tan^{-1}\frac{1}{\sqrt{5}}=8.75931 \text{ seconds}.$$

$$t_1=\frac{v\sqrt{5}}{g}\log\left(\frac{\sqrt{6}+1}{\sqrt{5}}\right)=9.03118 \text{ seconds}.$$

$$T=t+t_1=17.79049 \text{ seconds}.$$

Also solved by *HENRY HEATON*.